Comment	Response
TCEQ Enclosure No. 1 ***Comments on Preliminary Site Characterization Report (PSCR), Patrick Bayou Superfund Site – Deer Park***	
1. 1.1 Overview - The second paragraph explains that the southern portion of the bayou is tidally influenced. Figure 1-2 should be revised to clearly illustrate how much of the southern portion of the bayou is tidally influenced.	The extent of tidal influence is not quantified at this time. This will be part of the hydrology evaluation scheduled to begin in the fall of 2006.
2. 2.3 Through 2.4 Bathymetry and Bottom Substrate, Surface Water Characteristics – The TCEQ recommends that the text be revised to emphasize the bayou is characteristic of an estuarine environment.	Agreed – will modify accordingly in future Remedial Investigation/Feasibility Study (RI/FS) work products.
3. 2.6 Geology - The potentiometric map provided as Figure 2-14 is based on water levels measurements taken in 1998 to 2004 in the first groundwater bearing unit (GWBU). The potentiometric maps provided in future reports should include more recent data.	These maps will be produced as part of the Texas Risk Reduction Program (TRRP) for each facility in their evaluation of potential impacts to the Bayou. These data and report summaries will be included and evaluated in the RI as it moves forward. A Site potentiometric map will be produced with groundwater elevations to be collected concurrently in October 2006 at the Shell, OxyVinyls, and Lubrizol facilities.
4. 2.6 Geology - Potentiometric maps for the other GWBUs should be in the final characterization report, and future Remedial Investigation (RI) report(s).	These maps will be produced as part of the TRRP program for each facility in their evaluation of potential impacts to the Bayou. These data and report summaries will be included and evaluated in the RI as it moves forward.
5. 3.5 Physical and Chemical Data - The discussion on the constituents of concern did not include the detection of pesticides. The text should be revised accordingly to include a summary on pesticides since the constituent was listed in data summary tables for sediment provided in Attachment C of the report.	A full evaluation to identify and address constituents of potential concern (COPC) will be conducted during the RI, and COPC identified in that process will be evaluated as the project moves forward. The discussion in the PSCR was not intended as a comprehensive review of all COPC, but was a discussion based on constituents frequently identified as being a concern. Pesticides, if confirmed as COCs for the Bayou, are expected to be addressed as part of the RI.
6. 3.5.3.1 Through 3.5.3.4: The report includes a discussion on the implementation of physical controls from adjacent	The RI will include an evaluation of the natural setting of groundwater discharges to the Bayou and more detailed

Comment	Response
facilities to prevent impacted groundwater from discharging to the Bayou. However, the report does not include a discussion on whether the RI report shall include evaluation of potential groundwater discharge to Bayou that is not covered by the adjacent facilities physical controls.	evaluations of actual discharges as a result of modifications made as a result of groundwater controls and other anthropogenic changes. Based on this assessment of actual flow rates to the bayou over various portions of the shoreline, the incremental risk of such discharges will be assessed by evaluating information on groundwater quality in those areas. Currently, each facility that borders the Bayou is performing groundwater assessment activities in accordance with TRRP. We anticipate that an evaluation of potential groundwater discharge to the Bayou in the RI Report will include a summary of information from the TRRP evaluations. If there are potential impacts to the Bayou from groundwater discharge zones that are not evaluated and addressed to an appropriate extent by the facilities under TRRP, those areas will be evaluated in the RI.
7. 4.1 Current and Historical Activities – Specific discussion of historical and current land uses such as waste disposal areas, landfills, and impoundments is absent. Although we recognize the statement on page 39 that it is "the intent of the JDG to continue to have each individual facility address any groundwater issues under each facility's ongoing TCEQ-regulated TRRP program," it would seem that a careful evaluation of historical activities (and aerial photographs) could shed some light on possible historical sources, if historical sources are deemed relevant to the study objectives.	Historical sources will be evaluated as part of the RI as it pertains to future source control; however, it is not the purpose or intent of the RI to identify historical activities that are responsible for the existing state of the Bayou.
8. 4.3 Groundwater Discharge – This discussion seems to be particularly abbreviated here.	As additional information is obtained from the adjacent facilities or is gathered during performance of the RI, this information will be utilized to provide a better understanding of groundwater discharge to the Bayou. These discussions will be expanded as the RI moves forward. See response to comment 6.

9. 4.4 Spills - Spills of hazardous materials are not required to be reported to TPWD. The TCEQ and the Texas GLO (General Land Office) are the primary state agencies that respond to and track spills of hazardous substances in Texas. To determine whether any spills have been documented in Patrick Bayou, we suggest a review of the Texas GLO and TCEQ spill data.	These data will be reviewed as required in the RI.
10. 5.3 Human Health Conceptual Site Model (and Figure 5-6) - Although Patrick Bayou is not directly accessible to recreational fishermen, many people fish nearby at the San Jacinto Monument State Park. This park is about 1.3 miles downstream of the mouth of Patrick Bayou. Contaminated fish and crabs from Patrick Bayou could easily be caught and consumed by these fishermen, so the recreational exposure pathway should be considered complete, at least for ingestion of tissue. Although there is fish consumption advisory (not a ban) in the Houston Ship Channel, many people still catch and consume fish and crabs from this area.	The recreational fisherman exposure pathway is considered potentially complete but of unknown significance. This scenario will be evaluated in the preliminary risk assessment to determine whether it should be carried further in the quantitative risk assessment. Please see the attached revised Figure 5-6 indicating that pathway is considered complete.
11. 6.0 Preliminary Remedial Action Objectives - The third paragraph mentions that urban and industrial runoff may continue to be non-point sources of contamination to the site that will not be addressed by on-site remediation actions. We suggest that urban and industrial runoff should be evaluated as potential sources of site re-contamination before the initiation of on-site remediation actions and should be documented as part of the RI/FS. This is especially important for the industrial sources adjacent to the site. Appropriate control measures should be in place before remediation takes place. Section 8.4 discusses some plans for source identification, and we support this type of activity.	Agreed – Stormwater runoff from upstream urban properties will be evaluated to assess the impact of non-point sources of contamination to the Bayou. This evaluation is part of the first work package that will be implemented during the RI. Other potential sources that could re-contaminate the Site will be documented and addressed as part of the RI/FS.

12. 6.0 Preliminary Remedial Action Objectives –The first bullet on page 88 indicates that the primary PRAO will be to "prevent adverse effects on wildlife species that may feed at the Site and prevent measurable degradation of downstream ecosystems as a result for the transport of contaminated sediment from Patrick Bayou." We suggest that a related objective would be to prevent adverse effects on humans from the consumption of contaminated fish and shellfish from Patrick Bayou or the consumption of fish and shellfish that may become impacted due to the transport of contaminated sediment from Patrick Bayou. See related comment no. 11.	Noted.
13. 7.2 Institutional Controls (last paragraph) - The Houston Ship Channel also has fish consumption advisories for PCBs, organochlorine pesticides, and dioxins in fish and crab tissue (see TDSHS (formerly the Texas Department of Health) advisories ADV-3, ADV-9, and ADV-20). Advisories do not prevent people from fishing in an area. Additionally, advisories are lifted once tissue data indicates that levels have decreased to acceptable concentrations.	Noted.
14. 8.2 Vertical Distribution of Contaminants of Potential Concern – TCEQ agrees that the characterization to determine historical versus ongoing sources will be a key task in the overall effort.	Noted.
15. 8.3 Risk Assessment – Evaluation of all the exposure pathways and receptors for the Site risk assessment are not clearly identified in Section 8.3. All relevant exposure pathways and receptors should be evaluated in the risk assessment, and should not be eliminated as part of the preliminary site characterization pathways, such as	Please see revised Figures 5-2, 5-5, and 5-6 for updated exposure pathways. Groundwater and soils are considered potential off-site sources of contaminants to the Site (e.g., soil erosion to sediment, groundwater discharge to surface water), but are not exposure media for the Site. Groundwater and soils will be addressed as potential source media in the RI/FS. Surface water

groundwater discharge, or groundwater exposure as indicated in Section 5.3.2 . It is recommended that Section 8.3 be revised accordingly to list all the exposure pathways to be evaluated in the risk assessment.	and sediment exposure to receptors will address potential exposure to groundwater discharging to the site and soil runoff/erosion. Risks associated with off-site groundwater and soil contamination are being addressed under TRRP for the specific facility. Risk associated with these exposures will be incorporated into the RI/FS and risk assessment as appropriate to evaluate identified receptors.
16. 8.5 Feasibility Analysis - TCEQ recommends the final remediation program include future performance monitoring activities such as sediment depositional studies and analytical testing of near surface sediments, and/or the media to ensure the intended measure(s) are effective in preventing site re-contamination.	Agreed – The details of the monitoring program will be determined in the Record of Decision (ROD).
TCEQ Enclosure No. 2 ***Comments Prepared by TCEQ Technical Support dated June 9 2006***	
1. 1.2 Site History - The last paragraph on page 4 discusses the NPL listing for this site. We suggest that this section briefly summarize the primary reasons for the NPL listing. This would perhaps provide a better context for later discussions as to the end goal of the Superfund project.	Please refer to the EPA Hazard Ranking Document for the Site.
2. 1.2 Site History - Since sediment toxicity is presumably (see previous comment) an integral part of the NPL listing, we suggest that this summary (pages 2-4) indicate the sediment toxicity test duration, species, endpoints, and type (elutriate, pore water, bulk sediment) wherever this topic is discussed.	Please refer to the revised Table 3-2 attached, which contains this additional information.

<table>
<tr>
<td>3. 1.2 Site History - The discussions on page 3 note that Patrick Bayou was listed on the 1998 303(d) list due to sediment toxicity, dissolved copper, ambient water toxicity, and temperature. There is a statement on page 4 that the bayou was delisted for copper and ambient water toxicity. It would be helpful to include a table that summarizes the 303(d) listings. The following information is current to date:
<table>
<tr><th>List</th><th>Reasons for Listing</th><th>EPA Approval Date</th></tr>
<tr><td>2004</td><td>PCBs, dieldrin, chlordane, heptachlor epoxide in fish tissue; dioxin in catfish and crab tissue; acute toxicity in sediment to aquatic organisms; mercury in water; temperature.</td><td>May 8, 2006</td></tr>
<tr><td>2002</td><td>PCBs and pesticides in fish tissue; dioxin in catfish and crab tissue; chronic toxicity in sediment; temperature.</td><td>February 3, 2005</td></tr>
<tr><td>2000</td><td>Dioxin in blue crabs and catfish tissue; toxicity in ambient sediment; toxicity in ambient water; copper in water; thermal modifications.</td><td>December 19, 2002</td></tr>
</table>
</td>
<td>Noted.</td>
</tr>
<tr>
<td>4. 1.2 Site History - We suggest that Figure 1-3 reflect the dates of actual sample collections, rather than the date the report was issued. The figure should also reflect the citations for each event/study.</td>
<td>Agreed. A revised Figure 1-3 is attached to this response.</td>
</tr>
</table>

5. 3.0 Summary of Existing Information - We suggest the following changes/corrections for Table 3-1: • Contaminant Assessment of Patrick Bayou (TNRCC) was published in December 1996 (not 1986) and the sampling was performed in July 1994. • Surface water was not collected in the Superfund Preliminary Assessment. • TNRCC/TCEQ routine monitoring now includes benthic community assessment (since summer 2000 at 11273). TCEQ monitoring also includes an upstream station (17154, station "T" on the maps), since December 2002. • Add another column that provides a specific literature citation and/or internet link for each study. • The table should reflect the dates of actual sample collections (as applicable); in addition to the date the report was issued.	Agreed. Please see the revised Table 3-1 attached.
6. 3.0 Summary of Existing Information - We suggest the following changes to Figure 3-1: • The mapped locations for stations PB014 and PB015 are not where the samples were actually collected. The samples for PB014 were collected at the same location as sample point "8," and the samples for PB015 were collected at the same location as sample point "6". • Please add stations 11273 and 17154 to the map • The superfund sample locations in the Houston Ship Channel near Patrick Bayou and stations 2 and 1 from TNRCC 1996 should also be included on the map so that the information in Section 3.3 and Appendix C will be more useful.	Sample locations PB014 and PB015 have been revised as suggested. Please see the revised Figure 3-1 attached to the response. Data from outside of the Site boundary, including any relevant data from Houston Ship Channel and additional data within the Bayou, will be evaluated in the RI as the need arises.

7. 3.2 Long-Term Monitoring Programs - TNRCC Station ID 11273 is not depicted in Figure 3-1. This should be added to parallel the discussion.	Data from outside of the Site boundary, including any relevant data from Houston Ship Channel and additional data within the Bayou, will be evaluated in the RI as the need arises.
8. 3.2 Long-Term Monitoring Programs – TNRCC Station 11273 includes annual monitoring for benthic macroinvertebrates (since summer 2000). The TCEQ also began monitoring an additional site in Patrick Bayou (station 17154, "T") for water and sediment quality in December 2002.	Noted.
9. 3.3 Short-term and Synoptic Studies - TNRCC (2001) is not in the list of references in Section 10. Please add this to the list of references.	The reference is: TNRCC. 2001. Hazard Ranking System Documentation Record, Patrick Bayou Site, Deer Park, Harris County, Texas, TX0000605329. Prepared in cooperation with USEPA, Region VI, by Texas Natural Resource Conservation Commission, Site Assessment and Management Section, Superfund Site Discovery and Assessment Program, Austin, Texas, January 2001, 101 pp. This reference was listed under USEPA (2001) in the PSCR.
10. 3.3 Short-term and Synoptic Studies - The 1994 sampling of Patrick Bayou by the TNRCC and U.S. EPA Region 6 included routine water chemistry at 11 stations, not five.	Noted.

11. 3.5.1.2.1 Polynuclear Aromatic Hydrocarbons (PAHs) (and Figure 3-2) - Although higher total PAH values were found upstream of the site, the depiction in Figure 3-2 may be misleading. The distribution of the high molecular weight PAHs, (e.g. fluoranthene and chrysene) was very high upstream of the site. However, all the low molecular weight PAHs (specifically acenaphthene, acenaphthylene, anthracene, fluorene, naphthalene, and phenanthrene), were not higher upstream of the site; they were lower upstream and were highest at stations Y and 3. Because the distributions are so different, the low and high molecular weight PAHs should be plotted and considered separately.	PAH distribution within the Bayou will be assessed as part of the RI, with the assessment process outlined in the applicable work plan/work package. This evaluation will include potential urban and industrial sources and assess if the distribution of PAH constituents may be derived from different sources.
12. 3.5.1.5 Metals - Zinc was also quite high in Patrick Bayou sediments (up to 4000 mg/kg). We suggest it be included in this discussion.	The purpose of the PSCR was to provide a broad overview of the Site. Other COPC will be identified and evaluated as the RI moves forward.
13. 3.5.2 Surface Water - This section mentions that routine water chemistry data is available in the TCEQ database, but limits the discussion to metals primarily. Dissolved oxygen, temperature, and salinity are all very important parameters in estuarine systems. We suggest that the routine water chemistry data from the TCEQ database be included in this discussion, in addition to the metals-in-water data that is presented.	Agreed - These water quality data will be fully evaluated as the RI moves forward.

14. 3.5.4 Tissue - In the dioxin TMDL study (see values in comment 38) the tissue concentrations for PCBs and dioxins were compared to a screening value that was based on human health risk. For PCBs the TDH (Texas Department of Health) screening value (given in the TMDL report) was 47 ng/g, and for dioxins the concentrations were compared to the Texas Health Standard of 0.47 ng/kg. The TDSHS (Texas Department of State Health Services) also has issued fish consumption advisories for the Houston Ship Channel and Upper Galveston Bay for PCBs and organochlorine pesticides in fish tissue and for dioxins in fish and crab tissue (see TDSHS (formerly the Texas Department of Health) advisories ADV-3, ADV-9, ADV-20, and ADV-28). The existence of these advisories indicates that PCBs and dioxins, which are present in Patrick Bayou sediments at elevated levels, are being accumulated in the edible tissues of fish and crabs in the Houston Ship Channel system. One of the two blue crab samples collected from the mouth of Patrick Bayou (from the University of Houston TMDL dioxin study) exhibited a PCB concentration twice that (94.5 ng/g) of any of the other 67 crab samples tested. The other Patrick Bayou crab sample concentration was 44.5 ng/g, which is the fourth highest of the 68 crab samples from the Houston Ship Channel system.	Noted – This information will be considered as we move forward in the RI; however, existing historical information regarding these constituents and others in regards to potential bioaccumulation occurring in Patrick Bayou is limited. A definitive conclusion cannot be made at this time that PCBs and dioxins are accumulating in fish tissue. This information will be developed as we progress through the RI.

15. 3.6.1 Toxicity - We suggest that Table 3-2 be expanded to indicate the toxicity test duration and endpoints. Additionally, it would be helpful to indicate where in Appendix C this information is provided. Other corrections include: • Add ENSR (1995) information to the table (water and sediment). • The date for TNRCC (1996) should be July 1994. • The Neanthes porewater checkmark should be in the April 2001 row; not October 2000.	Agreed – Please see revised Table 3-2 attached.
16. 3.6.1 Toxicity – (Houston Ship Channel Toxicity Study, ENSR 1995) - This section discusses the surface water toxicity results from this study, but does not include the sediment toxicity results from this same study. Patrick Bayou sediment was sampled for toxicity to Mysidopsis bahia and Ampelisca abdita in 10-day whole sediment toxicity tests. Six Patrick Bayou samples were tested and significant effects were observed in many samples, depending on whether the responses were compared to that of control sediment or reference sediment (see Table 3.4-5 and Figure3.4-1 in ENSR, 1995). This information should also be added to Table 3-2.	Agreed – Please see revised Table 3-2 attached. Data from ENSR (1995) sediment toxicity tests reported in Tables 3-4 and 3-5 and Figure 3.4-1 will be included in future RI work products as appropriate when these documents have been received and verified.
17. 3.6.1 Toxicity – Assessment of Sediment Quality Data in Patrick Bayou (Parsons et al 2002) – Paragraph 2 identifies the polychaete tested as Nereis virens. The correct test species was Neanthes arenaceodentata.	Agreed – Please see revised Table 3-2 attached.

18. 3.6.1 Toxicity (Discussion of Toxicity Test Results) – The last bullet on page 50 suggests that sediment toxicity is not driven by metals based on the results of SEM/AVS ratio evaluations. Unless we can be sure that samples for the analysis of AVS were collected from the oxic, biotic zone of the sediment, this broad generalization may misrepresent the bioavailability of metals in Patrick Bayou. Further, the SEM/AVS approach does not apply to all metals.	The text was part of the overall summary of historical evaluations. The RI will include additional evaluation of potential SEM/AVS ratio effects.
19. 3.6.1 Toxicity (Discussion of Toxicity Test Results) – The discussion in the first bullet on page 51 appears to conflict with that on the bottom of page 49 regarding the possibility of pore water toxicity. This should be clarified. Also, we should keep in mind that the pore water tests were acute (96-hour) tests compared with the chronic bulk toxicity tests.	Agreed and noted. Porewater toxicity tests conducted with *Leptocheirus plumulosus* on sediments collected in October 2000 (N=4) and June 2001 (N=10) and *Neanthes arenaceodentata* on sediments collected in June 2001 (N=9) did not demonstrate any toxicity, whereas related whole sediment was toxic to *Leptocheirus* and *Neanthes* in 12 of 14 and five of nine cases, respectively. Two porewater samples (N=2) from sediments (which were toxic in whole sediment tests) collected in August 2003 were tested using *Americamysis bahia*, *Ampelisca abdita*, and *Leptocheirus*. One porewater sample demonstrated toxicity to all test species while the other demonstrated toxicity to *Ampelisca* only. In the sample demonstrating toxicity to all three organisms, ammonia-N levels were 56.7 mg/L. Based on the frequency of toxicity observed in porewater (4/29) compared to the whole sediment (27/29) for each organism and test, Parsons (2004) concluded that toxicants are tightly bound to sediment and that observed mortality in porewater from sediments collected in August 2003 may have been due to high ammonia-N concentrations. Discussion of porewater toxicity test results in subsequent RI/FS work products will describe porewater toxicity as infrequent relative to whole sediment toxicity; suggesting that toxicants may be bound tightly to sediments. It is noted that the

	acute nature of the porewater tests contribute some uncertainty of the potentially toxic nature of porewater in situ.
20. 3.6.1 Toxicity (Discussion of Toxicity Test Results) – Regarding the discussion of the 303(d) listings (last bullet), please see previous comment 3. The discussion here mentions the early water toxicity and the subsequent delisting, but it does not discuss the changes in the bayou discharges in the late 1990s which may have influenced this delisting. Samples from station PB015 (ENSR 1995) / station 6 (TNRCC 1996), located at the Shell bridge, were toxic in 1993 and 1994. Ammonia and calcium concentrations in water were high at this station during this time. The City of Deer Park, which had been discharging high ammonia, upgraded its plant in the late 1990s. Ammonia concentrations in the wastewater discharge were substantially reduced. Also, Shell Chemical outfall 001 discharge had been failing biomonitoring (whole-effluent toxicity) tests due to ionic imbalances related to high calcium in the effluent. This discharge was moved to the Houston Ship Channel in the late 1990s. In 2000 and 2001, when surface water toxicity tests were performed for Patrick Bayou, no ambient toxicity was observed at this site. Patrick Bayou was then delisted on the 2002 303(d) list for water toxicity.	Noted – This information will be carried forward in the RI.
21. 4.2 Discharge Outfalls. – "JDG" here and elsewhere, is not defined.	JDG is the Joint Defense Group – and consists of Shell, Lubrizol and OxyVinyls. This group has entered into an Administrative Order on Consent (AOC) with EPA for the RI/FS. Its definition is

	provided on Page 4 of the PSCR.
22. 4.7 Houston Ship Channel Interaction – The discussion should indicate when the once-through cooling water ceased to be discharged to Patrick Bayou.	Agreed – Once through cooling water has been used from an intake on the Houston Ship Channel since the initiation of industrial activities by Diamond Shamrock in the late 1940s. The use of this water for once-through cooling continued through the production of chlorine, which ceased in 2001. The operation of channel water intake continued after that time (to maintain operability of the intake and service utilities and caustic dewatering) and is currently active.
23. 5.2.1 Habitat Features (page 75) - The text here indicates the upstream portion has a gunite bottom, which contradicts earlier text indicating this section has a mud bottom. Please revise text for consistency.	The gunite-lined ditch has an earthen bottom—text will be modified accordingly in future RI/FS work products.
24. 5.2.2 Potential Ecological Receptors and Exposure Pathways – With the understanding that this was a fairly general, preliminary discussion, the potential receptors/pathways presented appeared appropriate.	Agreed.
25. 8.3.2 Ecological and Human Health Conceptual Site Models – We suggest that the text be expanded to indicate the circumstances which would indicate the need for additional sediment toxicity test data. This should include bulk and pore water tests (laboratory and in situ tests).	Because of the lack of consensus from previous toxicity testing data, we do not plan to utilize additional toxicity testing in the RI evaluations. It is expected that existing toxicity data will be evaluated as a line of evidence in the risk assessment. This type of testing may be part of the post-remediation monitoring program. The RI/FS will focus on the identification of the distribution of COPC, their potential effects, and identification of remedial options.
26. 8.5.2 Containment Methods – The term "AOI", needs to be defined.	AOI is defined as Area of Interest.

27. 9.1.1 Clean Water Act and State Water Pollution Control Laws - Patrick Bayou is also listed on the 303(d) list for total mercury in water, PCBs, dieldrin, chlordane, and heptachlor epoxide in fish tissue (in addition to the ongoing TMDLs for dioxin, sediment toxicity, and water temperature). Also see previous comment 3.	Noted.
28. 9.2.1 Preliminary ARARs for Surface Water – The statements regarding the applicability of chronic aquatic life criteria (in Patrick Bayou) are correct. Since Patrick Bayou is a tidal water body (and a tidal tributary of the Houston Ship Channel) it should also be evaluated as a sustainable fishery. Similar to the statement in Section 9.2.2 regarding the applicability of the sediment PCLs under the TRRP rule, §350.75 (i)(13) also requires that surface water PCLs be established when chemicals of concern (COCs) are present in surface water or when COCs will enter into surface water due to a release, and a surface water response action is necessary to protect human or ecological receptors. Therefore the "universe" of surface water evaluations should not be limited to the federal and state water quality criteria.	Texas Administrative Code (TAC) Rule §307.7, states that the establishment of numerical criteria for aquatic life is highly dependent on desired use, sensitivities of usual aquatic communities, and local physical and chemical characteristics. The physical characteristics and the historical and current uses of Patrick Bayou, likely preclude its ability to function as a fully "sustainable fishery." The designated beneficial uses for Segment 1006 of the San Jacinto River Basin which contains Patrick Bayou are navigation and industrial water supply (TAC RULE §307.10). In addition to evaluation of the Bayou for these beneficial uses, the RI will develop sediment and water quality objectives for the protection of potential ecological and human receptors when appropriate to maintain conformance with State and federal antidegradation policies (e.g., TAC RULE §307.5).
29. Appendix C-3 - The word "dissolved" should be deleted from the title since the table contains both dissolved and total results, and they are adequately labeled in each row.	Agreed – will be modified accordingly in all future RI/FS work products.

<table>
<tr>
<td>30. Appendix C-4 - The results in this table are mixed up, and should be corrected. The data reported in the TMDL reports are given below. In addition, more samples were collected in 2004 as part for the dioxin TMDL, which are also included below. The units should also be added, as indicated in bold.
<table>
<tr><th></th><th>Date</th><th>Species</th><th>Total TEQ Dioxin, ng/kg</th><th>Total PCB ng/g</th></tr>
<tr><td>Dioxin TMDL (2003)</td><td>8/28/2002</td><td>Blue Crab</td><td>8.489</td><td>44.5, 94.5</td></tr>
<tr><td></td><td>8/30/2002</td><td>Catfish</td><td>8.09</td><td>187.9</td></tr>
<tr><td></td><td>4/29/2003</td><td>Blue Crab</td><td>2.33</td><td>--</td></tr>
<tr><td></td><td>4/29/2003</td><td>Catfish</td><td>11.204</td><td>141.5</td></tr>
<tr><td>Dioxin TMDL (Nov 2005)</td><td>4/21/2004</td><td>Blue Crab</td><td>8.61</td><td></td></tr>
<tr><td></td><td>4/21/2004</td><td>Catfish</td><td>2.84</td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td></td></tr>
</table>
</td>
<td>Agreed – the data included in the table will be adopted and evaluated as necessary in future RI/FS activities. Please see the revised Appendix C-4 attached.</td>
</tr>
<tr>
<td>31. Appendix C-5 - Results presented here differ from the text in ENSR 1995 (page E-6). The ENSR report states that no water samples caused mortality to silversides, although two stations (not from Patrick Bayou) had significant reductions in growth. Appendix C-5 indicates toxicity for M. beryllina in August 1993 at station 15. Patrick Bayou (station 15) and one other station in the ENSR study demonstrated toxicity to mysid shrimp, which is consistent with the information in Appendix C-5. Please verify that the information in this appendix is correct.</td>
<td>Please refer to the Appendix C-5 attached.</td>
</tr>
<tr>
<td>32. Appendix C-8 – Please add the name of the test organism to this appendix (Neanthes arenaceodentata).</td>
<td>Please refer to revised Appendix C-8 attached.</td>
</tr>
</table>

TCEQ Enclosure No. 3 ***Comments Prepared by TCEQ Technical Support dated June 13,2006***	
Sec A Section 2.3 – Bathymetry and Bottom Substrate:	
A.1 Reference for the bank-to-bank riverbed elevation survey by Gahagan and Bryant Associates, Inc., should be formalized and, if possible, attached to the subject report.	No formal report other than the x,y,z data package is available.
A.2 The accuracy of the bathymetric survey (Sec A.1) is stated. However, the precision is unknown. Contours intervals for the Patrick Bayou Bathymetry in Figure "2-4" are 5-foot. Figure "2-4" is mislabeled "2-5." (There are two Figure 2-5's.) Figures in Appendix A use 2-foot contour intervals. Given the small range of depth variation in Patrick Bayou, a smaller contour interval is recommended.	Figure labels are corrected in the attached revised Figures. Additional incrementalization of data will be utilized as required in the RI/FS.
A.3 The trace of the line whose data are represented in Figure 2-5 should be shown on a map. The relevant depths and thicknesses vary *laterally* in Patrick Bayou (pools and runnels) and it is not clear what data Figure 2-5 represents.	The data in Figure 2-5 provide an overview of the bathymetry for the site. More detailed data are provided in Appendix A of the PSCR.
A.4 Sediment thicknesses are likely to become important. Figure 2-6 represents sediment isopach thicknesses with 2-foot contours. A smaller contour interval and larger map is recommended.	Additional incrementalization of data will be utilized as required in the RI/FS.
Sec B Section 2.6 – Geology:	
B.1 It is recommended that the final report incorporate all available hydrogeologic data (see Appendix B) relevant to contamination and transport to Patrick Bayou. Numerous cross-sections that tie together the available data from primary sources on either side of the bayou are considered essential.	Groundwater discharge to the Bayou will be evaluated as described in response to Comment 6. Their analyses and conclusions will be evaluated as the RI moves forward.

B.2 The term "… *almost classic water table surface* …" should be replaced with more specific terminology.	The potentiometric contour data shows that groundwater potentiometric surface elevations (the water table) for the upper saturated zone generally mimic the overlying topographic surface and that groundwater in this zone generally moves towards and discharges into the Houston Ship Channel and Patrick Bayou. This is considered a typical (or "classic") water table surface in most hydrogeologic text. More specific descriptions will be provided in the future.
B.3 Based on the variation of the site hydrogeology, Figures 2-12 and 2-13 should be augmented with additional locations along the bayou.	These analyses will be conducted as necessary as part of the TRRP program for each facility and it is expected that additional cross-sections will be produced and evaluated as the RI moves forward.
B.4 Table 2-2 shows an overlap of elevation between the second and third water-bearing units. This attests to the complex hydrostratigraphy (which requires further discussion) or is an error. Table 2-2 is not referenced in the text.	The overlap is due the complex hydrostratigraphy. Table 2-2 is referenced in the second sentence of Section 2.6.2 of the PSCR.
Sec C Section 5.1 – Physical Site Conceptual Model:	
C.1 While important, the physical conceptual model flow chart in Figure 5-2 should be considered for revision in a way which directs the flow chart towards exposure pathway-related processes. Confusion regarding the purpose of the site conceptual model may be lost if the emphasis on exposure pathway and related processes is absent. Matters not associated with the exposure pathways are distractions.	The site conceptual model has several purposes. Figure 5-2 summarizes contaminant sources, transport, and media. Exposure pathways and related processes are specifically considered in Figures 5-1, 5-3, 5-4, 5-5 and 5-6. Figures 5-1, and 5-4 are in the PSCR; 5-2, 5-3, 5-5, and 5-6 are attached.
C.2 Sediment transport is a potentially significant process (particularly for sediment toxicity issues) and a complex one. Conclusions regarding this process should be deferred until after an appropriate quantitative analysis has been completed.	Agreed.

C.3 The groundwater-surface water pathway is not adequately discussed considering its potential import. This exposure pathway requires significant discussion in the revised report. Figure 5-3 is illegible.	The groundwater to surface water pathway will be evaluated as data is developed, both in the Bayou and under the TRRP programs for adjacent facilities.
Sec D Section 7.9 – Hydraulic Modifications:	
D.1 This section is an allusion to the document in Appendix F, *Presumptive Remedy Selection Through Decision Consequence Analysis*, prepared for the Patrick Bayou Joint Defense Group. As described in that document (Sec 9.0), the Group is collectively agreed in principal to focus on hydraulic modification "… *to improve sediment stability* … ." Per Section 8.1 of the same document, hydraulic modification shall comprise a certain re-engineering of the bayou drainage system. Such engineering, as is typically executed today, can be expected to impact the eco-system profoundly – meaning it shall change (thus destroying the current eco-system). However, another agreement in principle of the group is that "… *Patrick Bayou can not be reasonable restored to pristine ecological conditions due to on-going anthropogenic impairments*." This implies the eco-system, as it is now known, is expendable. As such, it brings into question the futility of pursuing any sediment toxicity issue, at all. An interesting question becomes "*What pathway remains valid when the surface water system has been sacrificed?*"	This text is a summary of the Decision Consequence Analysis (DCA) conducted for Patrick Bayou with active participation and input form many stakeholders and agencies including EPA and TCEQ. It is meant to provide a consideration in the discussion on future Remedial Action Objectives. The DCA was a response to the difficulty the PRPs and the Agencies had encountered in previous investigations in selecting a course of action in light of the complexity of the data collected to date. The objective was identification of the most likely practical alternatives for creating a sustainable improvement in the ecosystem. The alternative arising from the DCA was recognized as useful for focusing future data collection efforts. EPA introduced the concept that this might ultimately be the equivalent of a "Presumptive Remedy." The DCA did not conclude the ecosystem was expendable. It identified the constraints to future restoration created by the realities of the existing industrial and urban land use. In addition, it should be recognized that the current estuarine system is itself an artifact of recent land use. Before the 1940s, approximately 80 percent of the current Bayou open water was uplands. In other words, the system being remediated didn't exist until the current land use activities modified the regional hydrology.

	Regarding the highlighted sediment toxicity statement, the TCEQ is correct. Given the degrees of freedom in the toxicity algorithm, it is highly unlikely that consensus will ever be reached as to the source, distribution, and significance of sediment toxicity. This does not mean the surface water system is sacrificed. To the contrary, it means that the best results will be obtained by focusing on preventing ongoing completion of potential risk pathways from the sediment and the Bayou into the larger ecosystem. This leads to the DCA conclusion that achieving stability of the sediment and elimination or reduction of transfer mechanisms will provide the most robust benefit from this remediation effort.
D.2 The use of weirs and other implements of wholesale hydraulic re-engineering shall require a significant engineering design analysis effort strictly for hydraulic engineering purposes. Environmental parameters typically are not quantifiable. Therefore, such considerations can not enter into such analyses. However, hydraulic considerations may still have associated environmental consequences during transient hydraulic events (*e.g.*, flooding) that shall require consideration.	Agreed.
Sec E Geotechnical Tests:	
E.1 The geotechnical tests described are appropriate and necessary for the bayou sediment dredging and the construction of the confined disposal facility, berms, and caps.	Agreed.

EPA Comments	
General Comments:	
There are two Figure 2-5's. The first in sequence is most likely Figure 2-4 (otherwise missing). The text (p 10 & 11) is correct.	Agreed – Please see the revised Figures attached.
Figure 2-11 is not readable. Suggest enlarging or recreating.	This figure will be revised to make it more legible if it is used in future work products.
Identify number and letter markers on Figure 3-1 (e.g., SE, PB, S, Q, 9, etc.). The Risk Assessment process will be enhanced if we know not only where and who, but what information was gathered from particular sampling stations. A small table in the text of § 3 would work well (even part of Table 3-1).	Agreed - Please refer to the revised Table 3-1 attached.
Figures 3-3 and 3-4 have numerous markers showing both concentrations above the lowest level (colors other than purple) AND non-detects (dot within shape). Make sure these are accurate and consistent with data.	Verified. The figures are correct - Some non-detect results with high detection limits result in this type symbol.
Figure 3-6 should show sediment thickness as Figures 3-2 – 3-9 do.	Agreed. Please refer to the revised Figure 3-6 attached.
"Parsons" should be identified as Parsons Engineering Science (Parsons ES) at least in the references section.	Agreed. All future RI/FS work products will identify Parsons as noted.
Figure 5-2: How are cooling water intakes a source? Are they leaching metals. What are they discharging (according to pathway)? How are "Air Particulates different from "Dust"?: This figure should include: 1) in-situ contaminated water (not runoff) as a secondary source, 2) the primary source and pathway leading to the secondary source "in-situ contaminated sediment" [suggest "Direct Discharge could link to contaminated bayou water and in-situ contaminated sediment], 3) sources, pathways and media resulting from contaminant volatilization to	Cooling water intakes from the Houston Ship Channel (HSC) draw in potential contaminants that are discharged into Patrick Bayou though the OxyVinyl outfalls. Regional air particulates are considered different from locally derived dust and may be an important consideration as an ambient source of contaminants such as mercury and dioxins. Please refer to the revised Figure attached.

air.	
Figure 5-3: This figure is not clear. Suggest enlarging or recreating.	The figure will be modified to make it more legible in future work products (attached).
Figure 5-5: If uptake by plants can be cross-referenced with "ingestion", then the ingestion pathways are not "na". Uptake should be included or cross-referenced with ingestion. Furthermore, the uptake pathway would be "complete and major (•)" between plants and water (especially for metals).	Agreed. Please refer to the revised Figure 5-5 attached. Uptake by plants is considered a complete and major pathway and will be evaluated in the risk assessment to the extent possible; however, there are limited toxicity information related to aquatic plants.
Figure 5-6: Contaminant volatilization from groundwater, soils and sediments and subsequent inhalation of vapors should also be considered here (see comment, Section 5.3). Also see comments, p 80, below.	Agreed. Please refer to the revised Figures 5-5 and 5-6 attached. Inhalation from surface water and sediments are considered complete pathways for the Site. Subsurface volatilization to air from upland soils and upgradient groundwater are being evaluated under the TRRP program. Results of this evaluation will be referenced and included in the RI/FS as appropriate.
Specific Comments (Page/Section/)	
10, § 2.3 Bathymetry and Bottom Substrate. ¶1, 4th sentence: "The accuracy of the survey…" Both values are listed as "vertical". Indicate which is actually "horizontal".	Agreed – will correct.
14, § 2.6 Geology. The first paragraph indicates the importance of impacts contaminated groundwater may have on sediments in the bayou. However, the second paragraph states that summaries focus on information relevant to groundwater and soils of shallow aquifers. Distinction between these two needs to	Noted – There is a large amount of information that will be collected and analyzed to understand the potential interaction and impacts of shallow soils and groundwater to the Bayou. These evaluations are beyond the scope of the PSCR and will be conducted for each facility under TRRP and carried forward in

be made. Also, if information relevant to Bayou sediments is lacking in the summaries, then it should be added.	the RI.
36, § 3.5.1.2.1: Define "ERM".	ERM signifies Effect Range Median (Reference: Long, ER et al. 1995). Incidence of adverse biological effects within ranges of chemical concentrations in marine and estuarine sediments. Environmental Management 19(1): 81-97)
37, § 3.5.1.2.1, 2nd bullet. Briefly describe what kind of temporal changes are readily apparent.	Concentrations of some contaminants appear to change significantly at the same sample station between sampling events. The temporal changes are not predictable, meaning that there is not a clear trend of increasing or decreasing concentrations. Changes exceed what would be expected from analytical uncertainties or spatial heterogeneity
46, § 3.5.4 Tissue. Figure 3-1 should be referenced regarding sampling station PB-016 of the ENSR study.	Agreed – will be modified accordingly in future RI/FS work products.
pp. 47, 49, 50, 51, § 3.6 Biological Data. Figure 3-1 should be referenced regarding any sampling stations discussed from previous studies.	Agreed – will be modified accordingly in future RI/FS work products.
47 & 49, § 3.6 Biological Data. Mysid shrimp, Mysidopsis bahia and Americamysis bahia are the same organism. The name, Mysidopsis was changed to Americamysis two or three years ago. Either name may be used for recognition purposes.	Noted.
50 & 51 § 3.6.1 Toxicity. 5th bullet: SEM = simultaneously extracted metals, not "soluble extractable metals"	Agreed – will be modified accordingly in future RI/FS work products.
50 & 51 § 3.6.1 Toxicity. 7th bullet: "Total PAH concentrations… a significant correlation with Leptocheirus survival".?? Is this correct? It is highly unusual that a correlation would be performed between a toxicant and survival rather than an adverse affect endpoint unless the chemical is suspected of	Text should be modified to read: "Total PAH concentrations … a significant correlation with Leptocheirus **mortality."** Text should be modified to read: "Metals and PCB **correlations** were not significant." All other comments are agreed and noted. Discussions in future RI/FS work products will be modified

causing hormesis. Double check the source of this observation. Also, correlation is a type of simple regression, so that statement is repetitive. Finally, "Metals and PCB regressions were not significant". Statistically, this statement makes no sense. Regressions themselves do not imply significance or the lack of in any way. They are a representation of data. Significance is determined by a subsequent correlation or other statistical analysis of the regression.	accordingly.
50 & 51 § 3.6.1 Toxicity. 8th bullet: It would be worth defining "303(d)" as that section of the Clean Water Act that regulates Total Daily Maximum Loads (TMDLs).	Agreed – will be modified accordingly in future RI/FS work products.
71, § 5 Preliminary Conceptual Site Model. 3rd sentence: The CSM does reflect factors that may "limit" human or ecological exposure, but more importantly, it illustrates and defines factors that contribute to exposure.	Agreed – will be modified accordingly in future RI/FS work products.
71, § 5 Preliminary Conceptual Site Model. Contaminant volatilization and vapor inhalation should also be considered throughout Section 5.1	The volatilization of contaminants from sediments and surface water will be evaluated. Please refer to the revised Figures 5-5 and 5-6 attached. Results of this evaluation will be referenced and included in the RI/FS as appropriate.
72, § 5.1.2 Release Mechanisms, last sentence. "Other potential… and leaching from impacted surface or subsurface soils impacts."	Agreed – will be modified accordingly in future RI/FS work products.
77, § 5.2.2.2 Benthic Invertebrates. Were any mollusks or barnacles observed along shorelines (their presence might be expected on rip rap)?	During a site/ecological checklist visit, no mollusks or barnacles were observed in those areas that were accessible to the shoreline.
77, § 5.2.2.3 Fish. Pelagic fish can ingest suspended sediment (Figure 5-5 includes this potential pathway)	Agreed – Please refer to revised Figure 5-5. This pathway is considered complete and will be evaluated in subsequent RI/FS work products (risk assessment).
77-78, § 5.2.2.4 Birds. Ingestion of water by each group of birds should be included as a potential exposure point even if minor	Agreed – Please refer to revised Figure 5-5. This pathway is considered complete and will be evaluated in subsequent RI/FS

(Figure 5-5 includes this)	work products (risk assessment).
79, § 5.3 Human Health CSM. Contaminant volatilization and vapor inhalation should also be considered throughout this Section.	Volatilization for sediments and surface waters will be considered. Please refer to the revised Figures 5-5 and 5-6 attached. Results of this evaluation will be referenced and included in the RI/FS as appropriate.
80, § 5.3.2 Potential Exposure Pathways. ¶2 of this page (previous section) states that there is "some potential" for use in the area downstream the bridge/pipeline although unlikely due to marine security zones. If ANY potential exists, then the exposure pathways (recreational: swimmer, fisher) are complete and must be assessed. Calculated risk values may be very low, however, they must be considered.	Volatilization for sediments and surface waters will be considered. Please refer to the revised Figures 5-5 and 5-6 attached. Results of this evaluation will be referenced and included in the RI/FS as appropriate.
80, § 5.3.2 Potential Exposure Pathways. Although groundwater has been deemed non-potable, potential for exposure due to volatilization should be considered.	Please refer to the revised Figures 5-5 and 5-6 attached. Inhalation from surface water and sediments are considered complete pathways for the Site. Subsurface volatilization to air from upland soils and upgradient groundwater are being evaluated under the TRRP program. Results of this evaluation will be referenced and included in the RI/FS as appropriate.
90, § 7 Identification of Potential Remedial Technologies, ¶2, 1st sentence. Provide citation for "USEPA Sediment Management Guidance Document". US EPA, 2005?	Agreed – Will modify accordingly.
99 § 8.3.2 Ecological and Human CSMs, Chemical Data. Sediment, Surface water and Biota are listed. Groundwater and soils should be included due to their potential contribution	Please see revised Figure 5-2, 5-5, and 5-6 for updated exposure pathways. Groundwater and soils are considered potential off-site sources of contaminants to the site (e.g., soil erosion to sediment, groundwater discharge to surface water) but are not exposure media for the Site. Groundwater and soils will be addressed as source media in the RI/FS. Surface water and sediment exposure to receptors will address potential exposure to groundwater discharging to the site and soil runoff/erosion. Risks associated with off-site groundwater and soil

	contamination are being addressed under TRRP. Risk associated with these exposures will be incorporated into the RI/FS and risk assessment as appropriate to evaluate identified receptors.
102, § 8.5.1 Natural Attenuation: Define "COC"	COC signifies Contaminants of Concern
103, § 8.5.2 Containment Methods, 1st sentence: Define "AOI"	AOI signifies Areas of Interest
Appendix C Summary of … Data. These tables need a legend defining acronyms etc. Suggest one legend for the entire appendix.	Agreed. Please refer to Appendix C legend attached.
Appendix C-8: State which organism(s) these results pertain to.	Agreed. Please refer to revised Appendix C-8 attached.
Appendix F Decision/Consequence Analysis. p 7, § 7.2, 2nd sentence: "Figure 3-2" should probably be Figure 7-2 as shown later in the Appendix.	Figure 7-2 is the correct reference.
Appendix F Decision/Consequence Analysis. p 10, § 7.3, 3rd sentence: "Figure 3-3" should probably be Figure 7-3 as shown later in the Appendix.	Figure 7-3 is the correct reference.
Appendix F Decision/Consequence Analysis. p 10, § 7.3, ¶4, last sentence: "The net benefit over a 30 planning period…" 30 days? 30 years?	The planning period is 30 years.

REVISED TABLES AND FIGURES

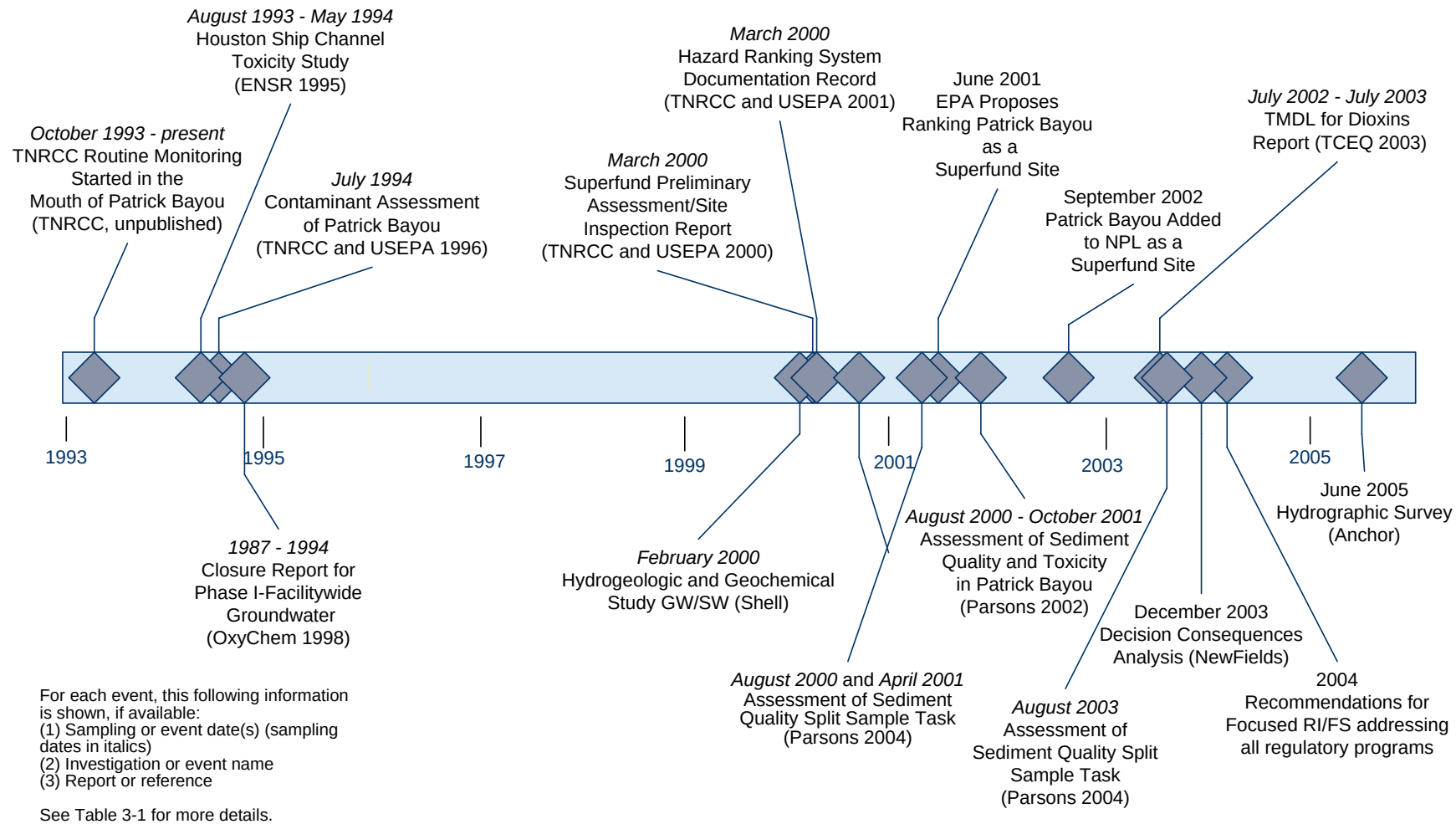

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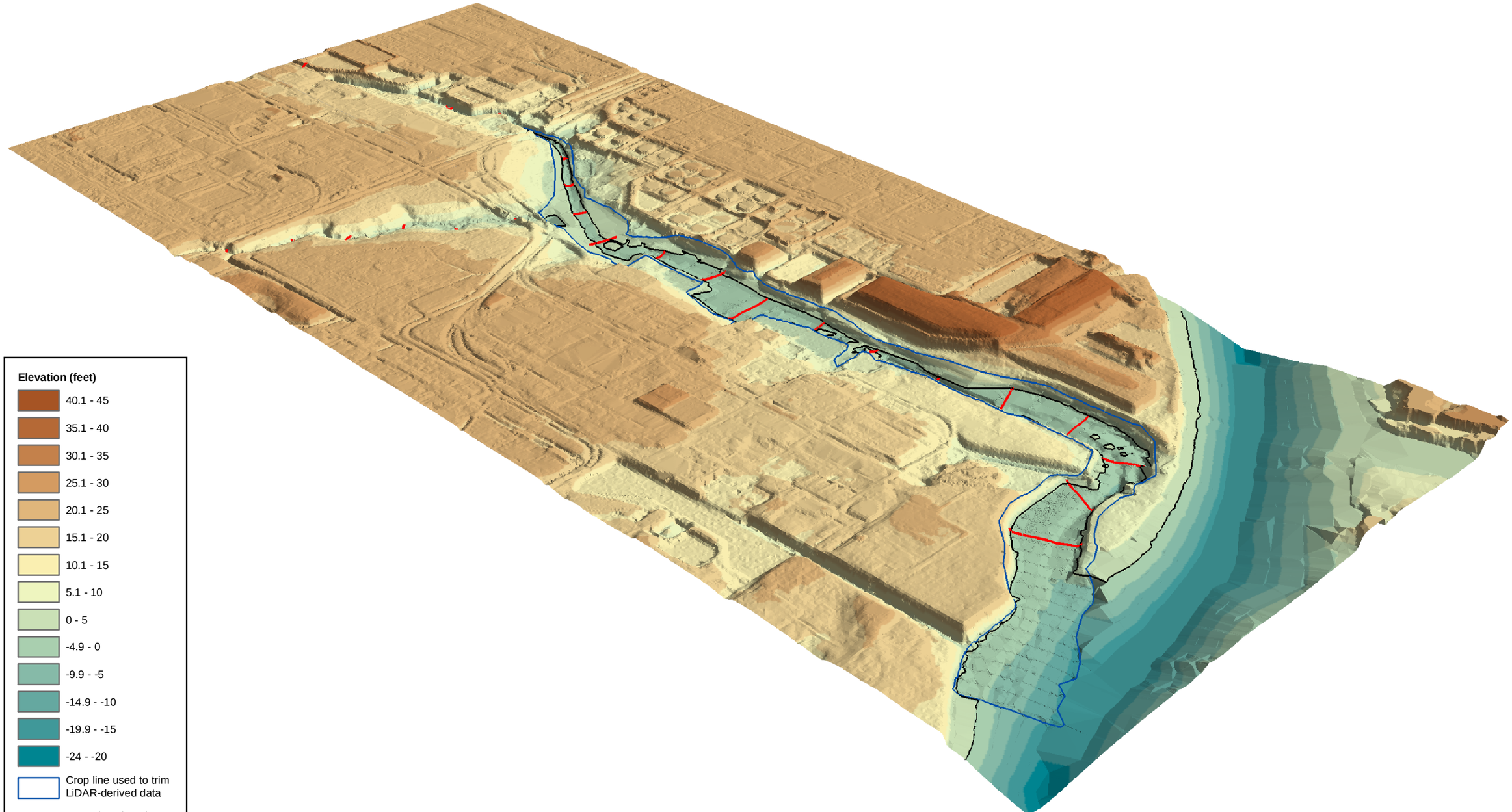
Figure 1-3
Timeline of Significant Environmental Investigations in Patrick Bayou
Preliminary Site Characterization Report



Elevations are given in National Geodetic Vertical Datum (NGVD).
LiDAR-derived data obtained from Tropical Storm Allison Recovery Project (TSARP).
Stations are placed in 500-foot intervals.

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Figure 2-4
Patrick Bayou Bathymetry
Preliminary Site Characterization Report

Table 3-1
Summary of Relevant Studies and Sampling Events for Patrick Bayou

Report Date	Study/Event/Sampling Date(s)	Information collected	Reference
1993	TNRCC Routine Monitoring Started in the Mouth of Patrick Bayou; sampling initiated October 1993	Periodic sediment and surface water data collected; including elutriate toxicity testing	TNRCC, unpublished data.
Jun-95	Houston Ship Canal Toxicity Study; samples collected Aug 93 - May 94	Sediment and surface water sampled at three stations for chemistry and toxicity testing. One blue crab tissue sample analyzed for dioxin/furans.	ENSR Consulting and Engineering. 1995. Houston Ship Channel toxicity study. Volume I and II. Document Number 1591-001-801. Prepared for the City of Houston.
Dec-96	Contaminant Assessment of Patrick Bayou (TNRCC); samples collected July 1994	Sediment and surface water sampled for analytical chemistry (10 stations), surface water and elutriate toxicity testing (five stations), and benthic community assessment (five stations) by TNRCC.	TNRCC and USEPA. 1996. Contaminant assessment of Patrick Bayou. Prepared by L Broach and P Crocker.
Jun-98	Closure Report for Phase I-Facilitywide Groundwater (OxyChem); series of eight investigative and/or sampling events beginning in 1987 and ending in 1994	Interpretation of boring log records, collection of hydrogeologic data, well water samples, pumping tests, stratigraphy, soil and groundwater quality	Oxychem. 1998. Closure Report for Phase I – Facilitywide Groundwater, Deer Park Facility, 1000 Tidal Park Road, Deer Park, TX 77536. Prepared by Occidental Chemical Corporation, June 1998.
Feb-00	Hydrogeologic and Geochemical Study GW/SW (Shell) ; July – Sept 1999	Surface and groundwater samples; bathymetry	Shell Chemicals, February 2000. Shell, Deer Park Facility Hydrogeological and Geochemical Study Groundwater and Surface Water at Patrick Bayou. Submitted to Texas Natural Resource Conservation Commission.
Mar-00	Superfund Preliminary Assessment/Site Inspection Report (TNRCC and USEPA)	Sediment from 15 on-site and seven background stations collected for bulk-sediment chemistry (field verification).	TNRCC and USEPA. 2000. Preliminary Assessment/ Screening Site Inspection Work Plan, Patrick Bayou, Deer Park, Texas, March 2000.
Mar-00	Hazard Ranking System Documentation Record (TNRCC and USEPA)	Patrick Bayou becomes eligible for listing on the NPL.	TNRCC and USEPA. 2001. Hazard Ranking System Documentation Record, Patrick Bayou Site, Deer Park, Harris County, Texas, TX0000605329, Vol. I of II, NPL-U36-2-7-R6, 105 pp., January 2001.
Jun-01	EPA Proposes Ranking Patrick Bayou as a Superfund Site	N/A	66 FR 32287, June 14, 2001
Sep-02	Patrick Bayou Added to NPL as a Superfund Site	N/A	67 FR 56757, September 5, 2002
Nov-02	Assessment of Sediment Quality and Toxicity in Patrick Bayou (TMDL Lead Organization); samples collected between August 2000 – October 2001	Sediment collected from 19 stations in Patrick Bayou for bulk sediment chemistry, solid-phase and porewater toxicity testing, and benthic community assessment by TMDL Lead Organization.	Parsons Engineering Science, 2002. Assessment of sediment toxicity and quality in Patrick Bayou, Segment 1006, Harris County, Texas. Prepared for Patrick Bayou TMDL Lead Organization

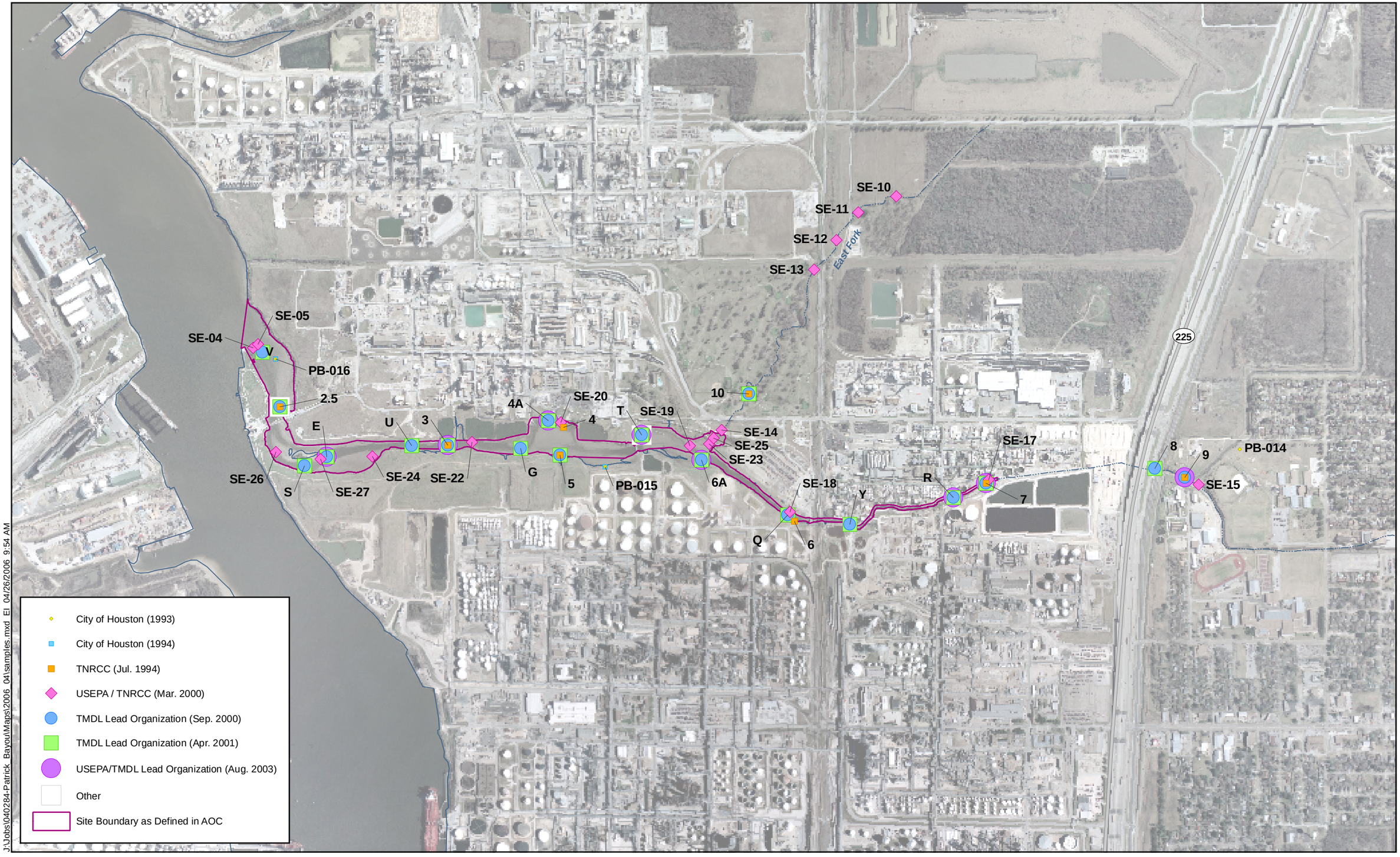
Table 3-1
Summary of Relevant Studies and Sampling Events for Patrick Bayou

Report Date	Study/Event/Sampling Date(s)	Information collected	Reference
Oct-03	TMDL for Dioxins Report (TCEQ) ; sampling in Aug 2002, May 2003	Includes results of dioxin and PCB tissue samples collected from two composite fish and shellfish samples collected in Patrick Bayou in August 2002 and May 2003.	University of Houston et al. 2003. Total maximum daily load for dioxins in the Houston Ship Channel. Final Report. Prepared for TMDL Program, TCEQ. Contract No. 582-0-80121.
Jun-04	Assessment of Sediment Quality Split Sample Task (TMDL Lead Organization); samples collected Sept 2000 – Aug 2003	Sediment samples collected from six previously sampled locations for bulk sediment chemistry, toxicity (solid-phase and porewater) testing, and benthic community assessment in joint TMDL Lead Organization/EPA effort.	Parsons Engineering Science. 2004. Assessment of sediment toxicity and quality in Patrick Bayou, Segment 1006, Harris County, Texas. Prepared for Patrick Bayou TMDL Lead Organization.

Table 3-2
Summary of Relevant Toxicity Studies for Patrick Bayou

	Whole Sediment						Porewater				Surface Water			Elutriate
	Leptocheirus plumulosus (amphipod)	*Neanthes arenaceodentata* (polychaete)	*Ampelisca abdita* (amphipod)	*Americamysis bahia* (mysid; = *Mysidopsis bahia*)	*Mercenaria mercenaria* (clam)	*Cyprinidon variegatus* (sheepshead minnow)	*Leptocheirus plumulosus* (amphipod)	*Neanthes arenaceodentata* (polychaete)	*Ampelisca abdita* (amphipod)	*Americamysis bahia* (mysid) (=*Mysidopsis bahia*)	*Americamysis bahia* (mysid) (=*Mysidopsis bahia*)	*Menidia beryllina* (inland silverside)	*Cyprinidon variegates* (sheepshead minnow)	*Cyprinidon variegatus* (sheepshead minnow)
TCEQ Routine Monitoring Program (unpubl.)														
Oct 1993 - present						9 days; survival							9 days; survival	
TNRCC (1996)														
July 1994											7 days; survival	7 days; survival		9 days; survival and teratogenicity
TMDL Lead Organization (Parsons 2002)														
Sept 2000	10 days; survival	10 days; survival												
October 2000							96 hours; survival							
April 2001	10 days; survival	10 days; survival					96 hours; survival	96 hours; survival						
TMDL Lead Organization (Parsons 2004)														
August 2003	7 & 10 days; survival		10 days; survival	7 & 10 days; survival	7 days; survival & growth		96 hours; survival		96 hours; survival	96 hours; survival				
Houston Ship Channel Toxicity Studies (ENSR 1995)														
1993 to 1994; five test series											N.A.; survival, weight	N.A.; survival		

Test duration and endpoint(s) are given for each study. Blank cells indicate no tests were performed. N.A. indicates that data were not available in appendices documenting toxicity studies.



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0 500 1,000 2,000
Scale in Feet

Aerial orthoimagery from USGS, June 2002.

Figure 3-1
Sample Locations for Sampling Events in Patrick Bayou
Preliminary Site Characterization Report

East Fork

225

2,3,7,8-TCDD (ng/kg)
- 0.2 - 10
- 11 - 50
- 51 - 100
- 101 - 500
- 501 - 1,100
- Site Boundary as Defined in AOC

Sediment Thickness (ft)
- < 2
- 2 - 4
- 4 - 6
- 6 - 8
- 8 - 10
- 10 - 12

- Non-Detect
- Detect
- Mar. 2000
- Sep. 2000
- Apr. 2001
- Aug. 2003

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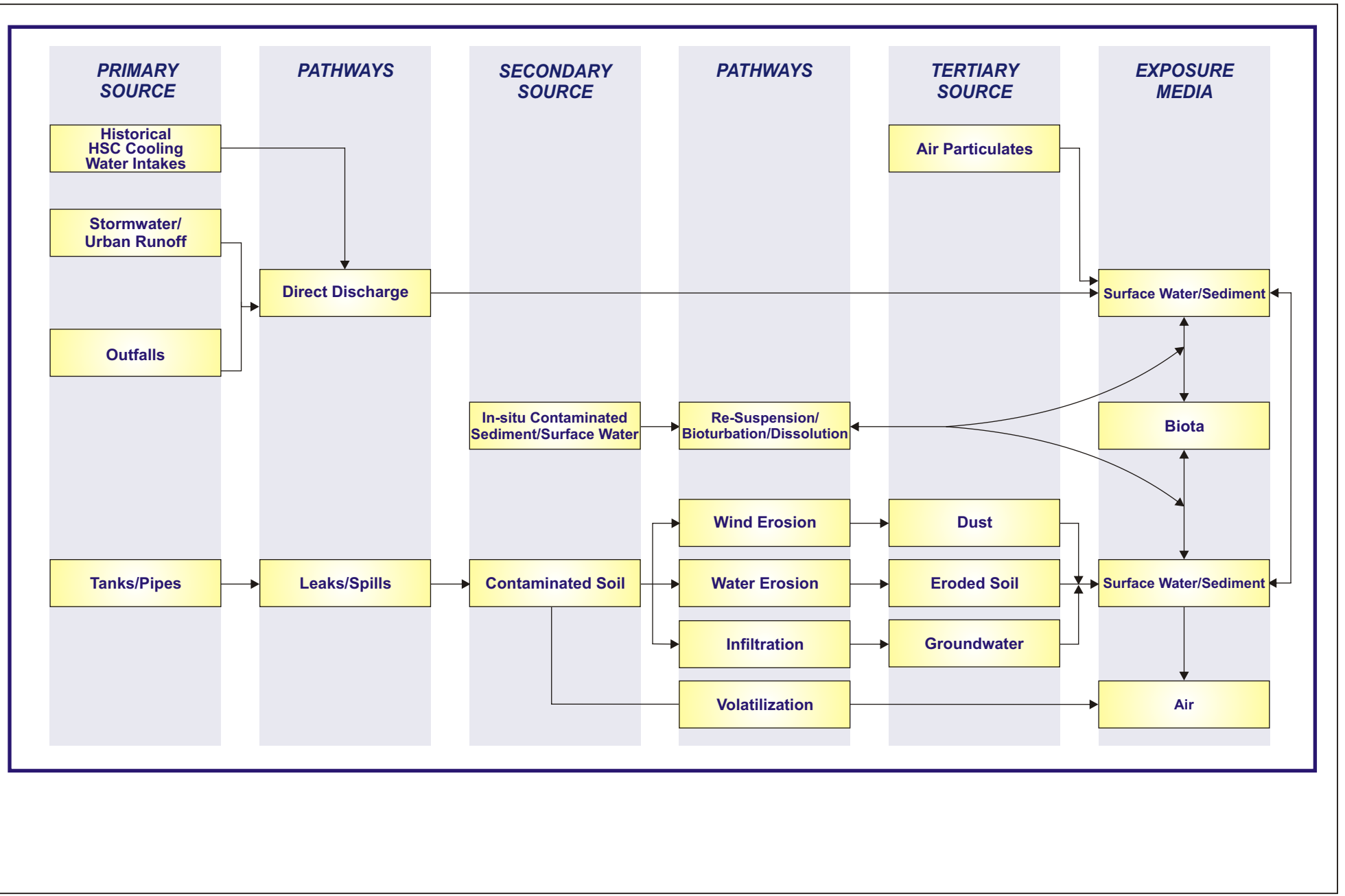
0 500 1,000 2,000
Scale in Feet

Data Sources:
TNRCC, January 2001
TMDL Lead Organization, November 2002
TMDL Lead Organization, June 2004
Aerial orthoimagery from USGS, June 2002.

Figure 3-6
Distribution of 2,3,7,8-TCDD in Patrick Bayou (2000-2003)
Preliminary Site Characterization Report



6/22/06 CVD K:\Jobs\040284-PATRICK_BAYOU\04028401\FIG 5-2.cdr

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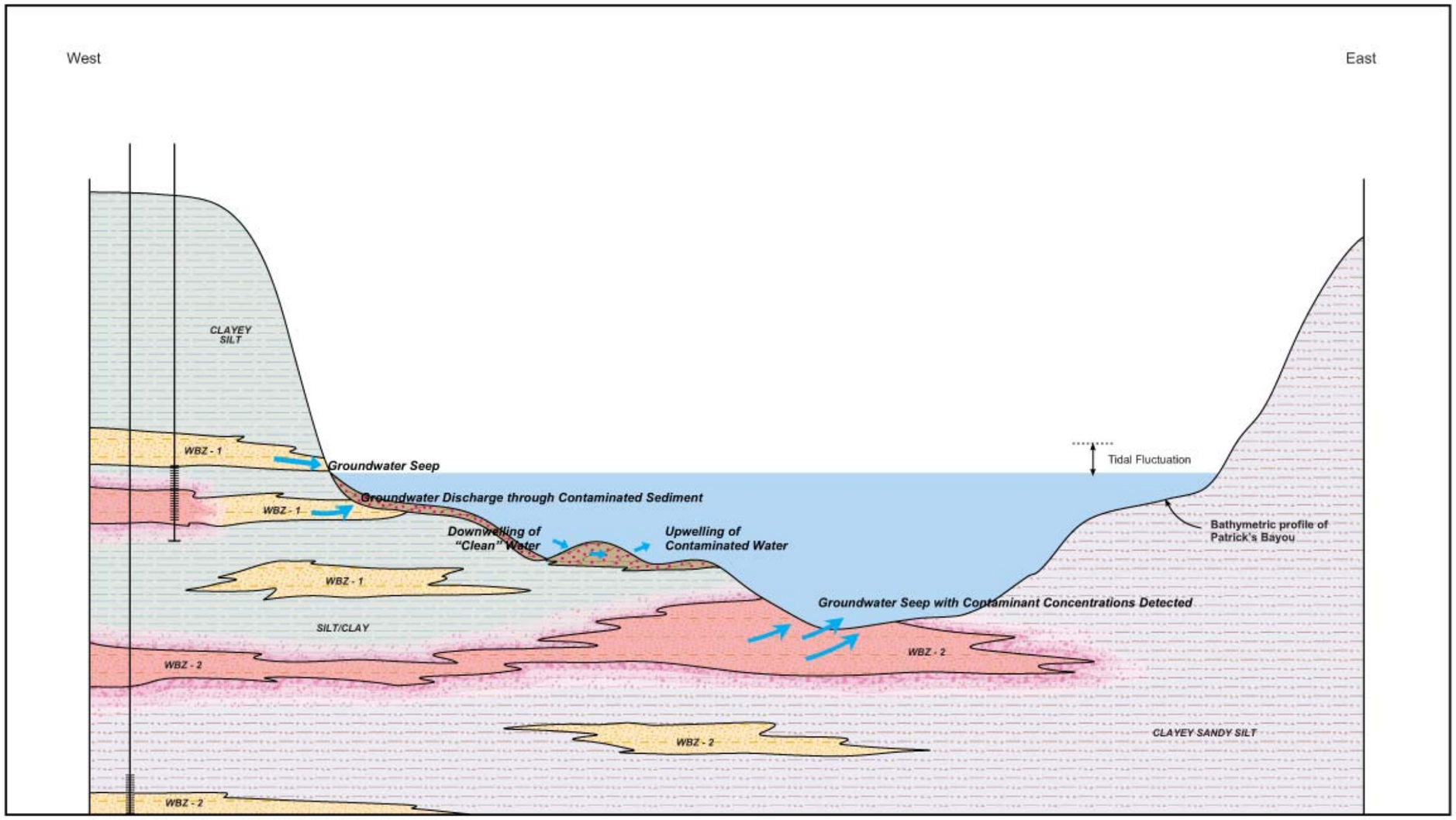
Figure 5-2
Sources, Transport, and Media in Relation to Physical Features of the Site
Preliminary Site Characterization Report



Prepared by Integral Consulting, Inc

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Figure 5-3
Conceptual Site Model for Groundwater
Preliminary Site Characterization Report

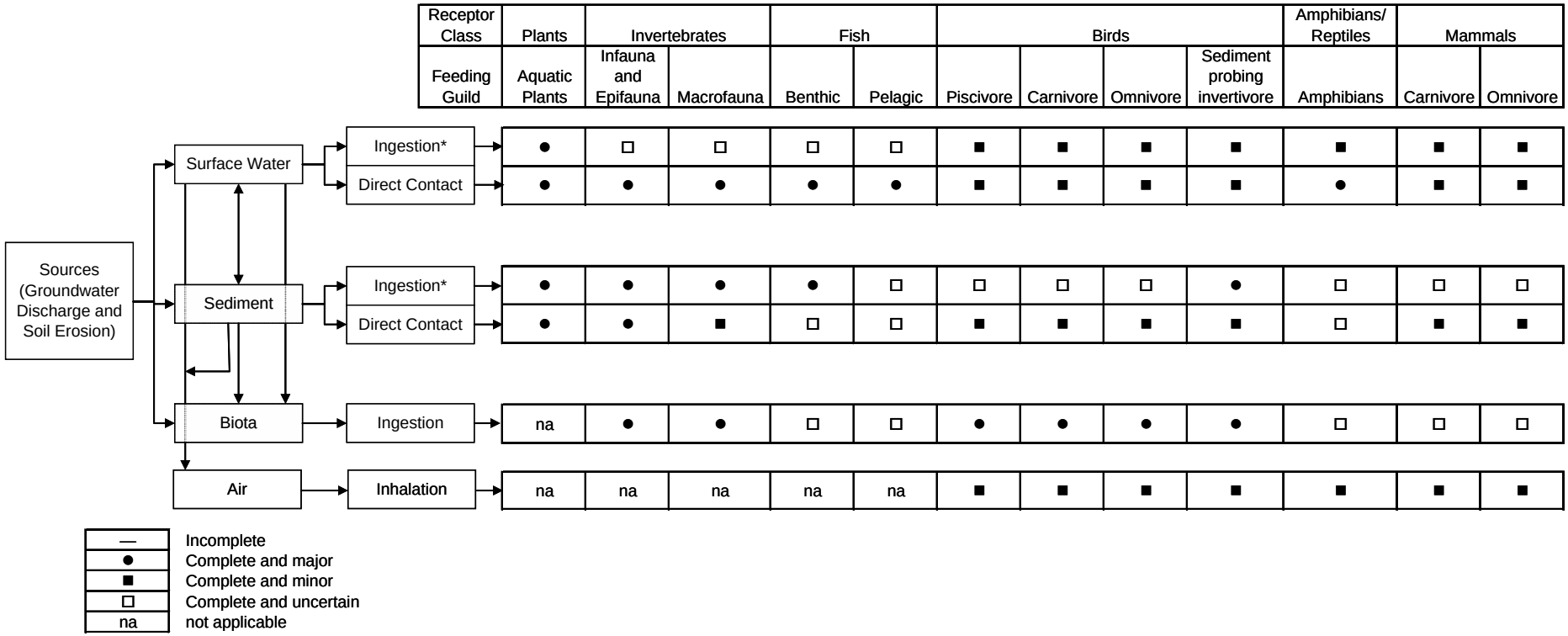

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Figure 5-5
Ecological Receptor Groups and Habitat Features
Preliminary Site Characterization Report

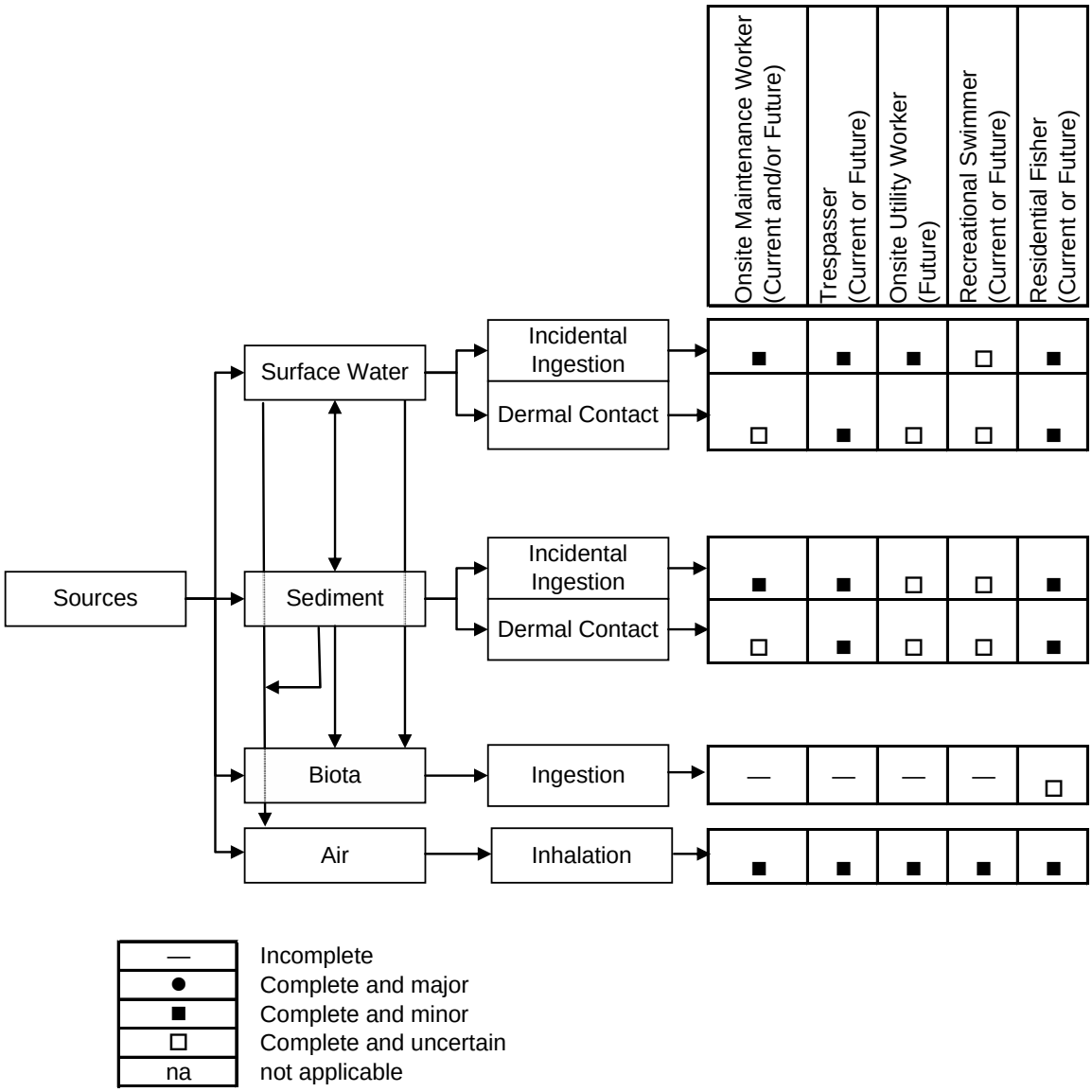

Figure 5-6
Preliminary Human Health Conceptual Model for Patrick Bayou
Preliminary Site Characterization Report

APPENDIX C
SUMMARY OF CHEMICAL, TOXICITY, AND BENTHIC COMMUNITY DATA

List of Acronyms and Abbreviations

BHC	Hexachlorocyclohexane (benzenehexachlorides)
BOD5	Biological Oxygen Demand, 5 day test
COD	Chemical Oxygen Demand
DDD	Dichlorodiphenyldichloroethane
DDE	Dichlorodiphenyldichloroethylene
DDT	Dichlorodiphenyltrichloroethane
Dioxins/Dibenzofurans	
HpCDD	Heptachlorodibenzo-p-dioxin (heptadioxin)
HpCDF	Heptachlorodibenzofuran (heptafuran)
HxCDD	Hexachlorodibenzo-p-dioxin
HxCDF	Hexachlorodibenzofuran
HxCDD	Hexachlorodibenzo-p-dioxin
PeCDD	Pentachlorodibenzo-p-dioxin
PeCDF	Pentachlorodibenzofuran
TCDF	Tetrachlorodibenzofuran
OCDD	Octachlorodibenzo-p-dioxin
OCDF	Octachlorodibenzofuran
TCDD	Tetrachlorodibenzodioxin
J	Estimated concentration
MEK	Methyl Ethyl Ketone (2-butanone, ethyl methyl ketone, methyl acetone)
MIBK	Methyl Isobutyl Ketone (hexone, isobutyl methyl ketone, isohexanone)
N	Normal
PAH	Polynuclear Aromatic Hydrocarbon
PCB	Polychlorinated Biphenyl
SVOC	Semivolatile Organic Compound
TEQ	Toxic Equivalency
TEQ (U=1/2)	Non-detected dioxin congeners included in TEQ calculations using ½ detection limit
TKN	Total Kjeldahl Nitrogen
TOC	Total Organic Carbon
TSS	Total Suspended Solids
U	Undetected
VOC	Volatile Organic Compounds
VSS	Volatile Suspended Solids

Appendix C-4
Summary of Tissue Chemistry Results for Patrick Bayou

Study	Date	Species	Average Total TEQ Dioxin, ng/kg	Average Total PCB, ng/g	TEF Source
Houston Ship Channel Toxicity Study (1995)	1994	Blue crab	0.82	--	I-TEQ (NATO 1988)
TMDL for Dioxins in Houston Ship Channel (2003)	August 2002	Blue crab	8.489	69.5	WHO-TEQ (van Leeuwek 1997)
		Catfish	8.09	187.9	
	April 2003	Blue crab	2.33	--	
		Catfish	11.204	141.5	
TMDL for Dioxins in Houston Ship Channel (Nov 2005)*	April 2004	Blue crab	8.61	--	
		Catfish	2.84	--	

Notes:
-- not measured
* reported by TCEQ

Appendix C-5
Summary of Toxicity Test Results from Houston Ship Toxicity Study (ENSR 1995)

Date	Aug-93		Oct-93		Dec-93		Feb-94		Mar-94	
Species	**M. bahia**	**M. beryllina**	**M. bahia**	**M. beryllina**	**M. bahia**	**M. beryllina**	**M. bahia**	**M. beryllina**	**M. bahia**	**M. beryllina**
Station										
14	N	N	--	--	--	--	--	--	--	--
15	Y	N	Y	N	N	N	Y	N	Y	N
16	N	N	--	--	--	--	N	N	--	--

Notes:
Y - Survival significantly less than control
N - Survival not significantly different than control
-- No test performed
M. bahia = *Mysidopsis bahia* (mysid; also known as *Americamysis bahia*)
M. beryllina = *Menidia beryllina* (inland silverside)